We would like to thank the reviewer for the useful comments. In the following response we will address each comment specifically (in bold).

Anonymous Referee #1

The manuscript presents the retrieval of phosgene ($COCl_2$) profiles from MIPAS limb emission spectra based on new spectroscopic line parameters. The applied retrieval scheme is described together with reasonable diagnostic material, like averaging kernels and error analysis. The scheme has been applied to a limited set of MIPAS data, which, nonetheless, seems adequate to fulfil the goal of the paper. From this period, mean profiles indicating the seasonal and latitudinal dependence of $COCl_2$ are discussed. For validation, comparisons with co-located measurements from the ACE- FTS instrument are shown. Since this manuscript contains essentially all information needed for characterization of a new MIPAS product, it is well suited for publication in AMT. Still I would strongly suggest to consider inclusion of results from the period when MIPAS measurements were obtained with higher spectral resolution.

The main objective of our paper is to demonstrate the feasibility of the phosgene profile retrieval from MIPAS spectra. We also put a significant effort in the characterization of both the error budget and the spatial resolution of this new product. As mentioned in the paper, due to computing limitations, we do not process an extended set of MIPAS measurements, we focus our study on a set of MIPAS OR (Optimized Resolution) measurements. The reviewer suggests to extend our study to include also a set of Full Resolution (FR) MIPAS measurements. We prefer, however, to keep excluding FR measurements from the present paper for the following two reasons.

a) For all the target constituents retrieved from MIPAS spectra by the ESA Level 2 processor, the FR measurements always provide retrieval products with accuracy very similar to that obtained from OR measurements. In particular, when the retrieval of a new weak species is concerned, FR measurements are never considered more challenging than OR measurements. Actually, the better spectral resolution of the FR measurements (0.025 vs 0.0625 cm^{-1}) compensates their coarser spatial sampling as compared to OR measurements.

b) An additional outcome of our study is that phosgene is now being considered by ESA as a candidate for inclusion in the operational Level 2 products version 8. For this reason, dedicated auxiliary data for the retrieval of phosgene from FR spectra will be developed and tuned as soon as version 8 Level 1b spectra will become available (but this will not occur in short term). Therefore the work suggested by the reviewer will be done anyway, but this will be part of a more extensive study that will include also the analysis of the trend of phosgene as inferred from the ten years of MIPAS measurements.

Further, the retrieval would be even more convincing if the improvement of the fit by including $COCl_2$ could be shown in the spectral residuals.

Here it is not clear whether the reviewer comment refers a) to the introduction of the paper where we report the story behind our motivation to study the feasibility of phosgene retrieval, or b) to the residuals obtained in the presented phosgene retrievals.

In case a), since in the introduction of the paper we only briefly recall the story of how the contribution of phosgene in MIPAS spectra was discovered, certainly at this stage it is not worth to introduce a detail discussion on the residuals of the F11 retrieval. This would result in an unnecessary digression outside the focus of our paper.

Case b). If, more likely, the reviewer comment refers to the residuals we observe in our phosgene retrievals, then a more circumstantial answer is necessary. As highlighted by the plot in the center panel of Fig. 1 of the paper, phosgene contribution to the observed limb-emission spectrum consists of a broad spectral feature with a peak intensity of the order of 15 nW/(cm^{-1} sr cm^{2}) with much weaker lines on top of it. The retrieval collects information on phosgene from several 3 cm^{-1} wide MWs (see Table 1 of the paper) spread over the whole phosgene band. Within each of the individual (narrow) MWs, most of the phosgene signal appears, therefore, as a contribution nearly constant versus wavenumber. However, the retrieval does not interpret the phosgene contribution as atmospheric continuum signal for the following two reasons:

1. **The broad spectral shape of the phosgene emission band is sampled in different places by the used MWs, therefore the retrieval cannot assign independent intensities to the phosgene signal in the different MWs.**
2. **The atmospheric continuum and the phosgene amount behave differently as a function of altitude. This feature makes atmospheric continuum and phosgene amount independent retrieval parameters.**

This explained mechanism, however, is not self evident when looking at an average residual spectrum obtained for a given MW at a given altitude: the phosgene contribution erroneously appears to the eye as an "uncompensated" atmospheric continuum signal. As an example, in Fig. A of the present document we show an average residual spectrum. For the reasons explained above, the inspection of such a plot could be of little help or misleading even for the most expert spectroscopist. Therefore we would still prefer to avoid including similar plots in the paper.

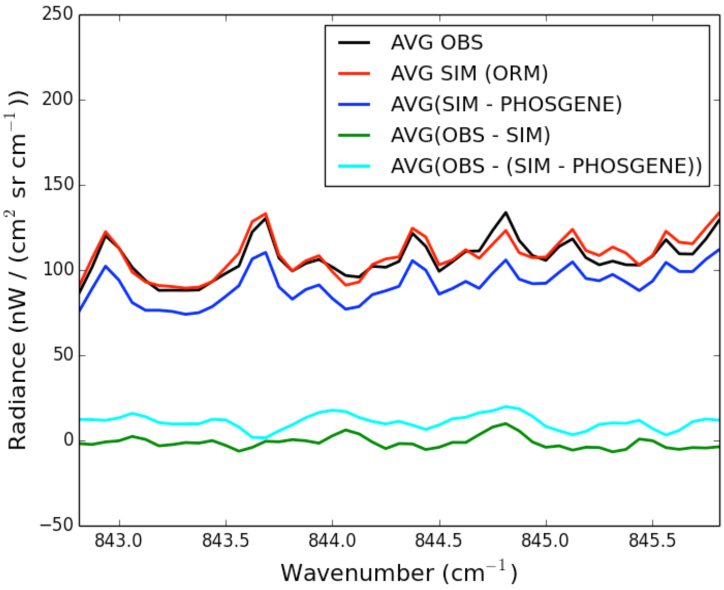

Fig. A. Average of 97 observations and simulations with tangent heights within the 21.5-24.5 km interval. Black: observed spectrum, red: simulated spectrum taking into account phosgene emission, blue: simulated spectrum ignoring phosgene emission. Cyan: residual spectrum (observation minus simulation) when simulation ignores phosgene emission. Green: residual spectrum obtained when simulation includes phosgene emission.

Specific comments:

P3L22: 'ESA-supported project'

Please specify the project (project title/number, reference if possible)

The validation of the ORM algorithm was made during the so-called "Support to MIPAS Level 2 processor Verification and Validation - Phase F" project. The contract number is: ESRIN/Contract No. 4000112093/14/I-LG. The name of the project is now included in the paper, the contract number is reported in the acknowledgements section.

P4L15: In the error analysis further down in the manuscript, also the line-width uncertainty has been considered. Could this be included here?

To avoid repetitions, in the new version of the paper we moved the discussion of the estimation of the error on the new phosgene spectroscopic data from the 'Spectroscopic Data of COCl2' section into the 'Retrieval Method' section.

P5L25: 'error budget'

The assumptions on the error quantities should be given or referenced (e.g. how large was the radiometric uncertainty assumed . . .)

The perturbations applied to the atmospheric or model parameters reported in this paper are those adopted by Anu Dudhia in

http://eodg.atm.ox.ac.uk/MIPAS/err/

to evaluate the error budget of the MIPAS key products derived by the ESA Level 2 processor. This website is now cited in the 'Retrieval Method' section of the revised paper.

P7L1: 'interpolated' How has the interpolation been performed?

Done. 'interpolated' -> 'linearly interpolated in log pressure'

P7L30: 'interpolated' How has the interpolation been performed?

Done. 'interpolated' -> 'linearly interpolated in log pressure'

P8L12: 'Thanks to a new spectroscopic database of phosgene. . .'

Is it really the new database which made the retrieval possible? E.g. ACE-FTS has obtained COCl2 profiles without this new dataset. Please consider another wording.

This part of the sentence has been removed from the revised paper.

Technical:

All the technical corrections have been implemented in the revised version of the paper as suggested by the reviewer.

In Table 1 heading we have change 'Frequency with 'Wavenumber', 'Initial' with 'Starting' and 'Final' with 'Ending'